

Degradation of 1,4-Dioxane and CVOCs by Iron-Impregnated Activated Carbon (CAT100)

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Background/Objectives. Many sites are contaminated with a mix of compounds such that no single remediation approach addresses the mixture. CVOC-impacted sites that include 1,4-dioxane in the mix are notoriously problematic, and the best approaches employ multiple remedies, which exacerbate costs.

RPI investigated the potential of CAT100 as a single-step remedy for such sites. CAT100 is granular activated carbon impregnated with metallic iron combined with nutrients, substrate, and a proprietary consortium. Step 1 involved screening the CAT100 consortia to verify that it contains microorganisms capable of using 1,4-dioxane as a sole carbon source. The second step was bench testing using groundwater from a candidate site. The principal site contaminants are 1,1,1-trichloroethane and 1,1-dichloroethene, although a suite of other chlorinated solvents is also present along with 1,4-dioxane. The last step is proving the efficacy of CAT100 at a pilot site in New Jersey.

Approach/Activities. RPI engaged an outside biological laboratory to screen the individual microorganisms used in CAT100 to look for organisms with the ability to use 1,4-dioxane as the sole food source supporting growth. The typical protocol is to streak the individual strains on non-nutrient agar (NNA).

Historical work demonstrated that granular activated carbon impregnated with metallic iron is a more effective absorbent for 1,4-dioxane than standard activated carbon. This effect is presumed to be due to an interaction between the embedded metal and 1,4-dioxane. The bench test measured the enhanced absorbance and synergy between the impregnated carbon and catalyzed biological degradation of mixed CVOCs, including the 1,4-dioxane.

Multiple parameters are evaluated in the bench test to identify optimal conditions, substrates, and nutrients for application in the pilot testing.

Results/Lessons Learned. The presentation will detail the screening procedure to identify microorganisms capable of degrading the 1,4-dioxane. Biological testing demonstrated that 12 microbes in the CAT 100 consortium were capable of growth on 1,4-dioxane. The bench test showed rapid degradation of the CVOCs and 1,4-dioxane. Before the bench test, it was unknown whether the CAT 100 technology could eliminate 1,4-dioxane and the CVOCs. Butanol, contrary to the published literature, did not improve degradation. The addition of pea fiber and starch did increase degradation. The main discussion will focus on the bench test.